UNIVERSITY OF PENNSYLVANIA

AN ANALYTICAL AND COMPARATIVE STUDY OF THE BINET-SIMON TEST RESPONSES OF 1,306 PHILADELPHIA SCHOOL CHILDREN WITH AN ATTEMPT TO EVALUATE AND GRADE THE SEPARATE TESTS

ARTHUR PHILLIPS

A THESIS

IN PSYCHOLOGY

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
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Introduction

In 1896 Binet and Simon published an article entitled "La Psychologie Individuelle"[1] in which the authors contended for the testing of complex mental functions, maintaining that the simpler analytical tests of experimental psychology tested processes in which individuals differed least and that individual differences are greater in the more complex mental processes. Ebbinghaus in Germany had reached the same conclusion. The German and the French psychologists arrived at the same point after patient and extended investigations of elementary processes in the way that had been in vogue since the time of Sir Francis Galton. In some respects Ebbinghaus and Binet present an interesting parallel. The experiments of Ebbinghaus that resulted in the famous curve of forgetting were performed with himself as subject and observer and with no other assistance than that of his wife. Binet performed one of his most interesting experiments upon his two daughters, Marguerite and Armande, and published the results in 1902,[2] which demonstrated the value of individual psychology and emphasized the importance of qualitative analysis.

Ebbinghaus, in his experiment upon himself, investigated with the use of nonsense syllables what has come to be known as the

[1] Binet, Alfred, and Simon, Th. La psychologie individuelle. *L'Annee Psychologique,* Vol. I.

[2] Binet, Alfred. L'etude experimentale de l'intelligence.

memory span, but which more accurately may be described as a comprehension-discernment span. This in itself was a departure from the simpler analytical laboratory experiments of the experimentalists. A further departure was brought about when he was called upon, in the city of Breslau, to aid in the solution of the problem of fatigue as affecting the work of school children. It was for this experiment that Ebbinghaus invented his well-known completion test which proved to have a higher correlation with degree of intelligence as estimated by scholastic grades and age than either rapid mathematical calculation or the attention span for digits. This completion test manifestly was exploring a complex mental function. Its success in this investigation as a test of intelligence led Ebbinghaus to define intelligence as the ability to combine or see relations between items of experience. Similarly Binet was called upon in 1904 by the Minister of Public Instruction of Paris to assist in devising a test to separate out from the school population subnormal children for purposes of instruction. The result of this effort on the part of Binet and his collaborator Simon was the formation of the scale of 1905.

This introduction serves to call to our attention that the Binet-Simon test is a battery of individual tests that aims to explore the complex mental process or processes that an individual is called upon to use in his everyday contact with life situations. Just what this complex is, it is exceedingly difficult to state. Binet in inventing the term "mental" to describe the level of performance normal to children at different chronological age levels was thinking of it in terms of mentality. When Terman adopted the name Intelligence Quotient to express the ratio between chronological and mental age, he was thinking of it in terms of intelligence. Actually, it has come to be recognized that what the Binet-Simon test yields is a performance level. Founded as it is upon long and careful observation of actual achievements in learning on the part of children, it brings children into competition with other children whose performances have been measured and standardized in order to measure the achievement of those being tested, and on the basis of this achievement to make an estimate of future achievement. It is a measure of proficiency demonstrated and to some degree measured at a particular time and place upon the basis of which an estimate is made of the child's ability to advance further along the curve of progress.

The Binet-Simon Test is used in the Psychological Clinic of the University of Pennsylvania, founded by Lightner Witmer in 1896, the year of the appearance of Binet's article on individual psychology. It serves a valuable purpose as a tool for preliminary orientation in the study of clinical cases. It is not looked upon as an exclusive or a final index of a child's proficiency, but is used along with other measures of proficiency in arriving at a clinical picture and a consequent diagnosis of the child and the child's ability to make those changes which we call progress. As a clinical tool, its value consists not only in the fact that it yields a single index, either mental age or Intelligence Quotient that enables the clinician to give the child a quantitative rating, but also in the use that may be made of it for qualitative diagnosis. It is of value, first of all, because it gives the clinician an opportunity to observe the performance of the child and to make qualitative judgment in the entire field of exploration of human personality. Secondly, it is of value when careful and accurate analysis is made of the tests passed and failed by the subject. Such analysis often reveals the presence of a personal defect, ability, talent, or shows the influence of home and social background.

When a child passes tests in advance of his chronological age the question is often raised in the mind of the examiner whether these tests located at the higher levels indicate that the child has in some directions advanced beyond his years. This would obviously be the conclusion if the tests in the battery represent a series of tests graded with reference to each other and with reference to an absolute or hypothetical zero point. It would be the case provided that each test at each level should prove to be rightly located at that level. It might be possible that in the tests at the twelve year level, which as a whole very accurately represents the performance of the modal twelve-year-old child, there may be tests too easy for the level and others too hard and that this disparity or unevenness in the value of the tests is obscured in the battery taken as a whole or in the levels taken as a unit. To those who are interested primarily in the generalized human adult and in the establishment of laws that represent tendencies such questions are secondary, but to the clinical psychologist they are of primary importance. For the clinical psychologist is interested in *this* child and in *this* performance at *this* particular time and place. It was such considerations that led to one aspect of this study, an attempt to break up the battery of Binet-Simon tests (Stanford Revision)

and to grade them according to their difficulty both with reference to each other and with reference to a zero point of difficulty.

As developed, the study falls into three parts or objectives:

(1) To show the relation between percentage of successes in passing the test and acceleration and retardation in school work.

(2) To arrange the tests according to the degree of difficulty as shown by the percentage of passes of each test.

(3) To show the development of ability to pass the several tests from the third grade to the fifth grade and from the fifth grade to the sixth grade.

The Sources of Data

The sources of data of this study are the Binet-Simon responses of 1,306 Philadelphia school children. Four hundred and six of these children were in the third grade, 500 in the fifth grade, 400 in the sixth grade. Their Binet-Simon performances were part of three investigations conducted recently by the Psychological Clinic of the University of Pennsylvania.

Third grade. The Eight Year Level of Competency, Genevieve McDermott-Murphy (an unpublished Mss. in Department of Psychology, University of Pennsylvania).

Fifth grade. The Ten Year Level of Competency, Miles Murphy, *Psychol. Clinic,* 1928, 17, 33–60.

Sixth grade. The Performance Level of Children in the Sixth Grade in Two Philadelphia Public Schools, Carl L. Altmaier, Jr., *Psychol. Clinic,* 1931, 19, 233–257.

Procedure

First, a statistical study of each group was made giving the mean, the standard deviation, the skewness, the Pearson Coefficient of Variation (V), probable error of the average. These measures were computed for the chronological age of the entire group and of one sub-group in each grade, covering a range in chronological age in each case of two years, and for the Intelligence Quotient of both of these groups and for two sub-groups, both of which represent a single chronological age. These groups are subsequently referred to as Groups III, II, and I respectively. These statistics are given in Table I.

TABLE I

Third Grade

Chron. Age	Mean	S.D.	Skewness	V.	P.E. av.	No. Cases
7–5 to 14–4	C.A. 104.8	± 9.53	+.60	9.08	.31	406
	I.Q. 100.5	±14.15	+.008	14.07	.47	
7–6 to 9–5	C.A. 105.4	± 5.25	+.75	4.9	.14	303
	I.Q. 104.09	±11.50	+.08	11.04	.44	
7–6 to 8–5	I.Q. 108.8	± 9.25	+.36	8.50	.58	113
7–10 to 8–1	I.Q. 110.2	± 9.25	+.35	8.39	.99	39
Fifth Grade						
8–11 to 17–3	C.A. 133.8	±14.58	+.71	10.89	.42	500
	I.Q. 99.0	±16.40	−.05	16.56	.47	
9–6 to 11–5	C.A. 126.3	± 5.97	−.01	4.72	.32	331
	I.Q. 105.2	±13.98	+.29	13.28	.49	
9–6 to 10–5	I.Q. 110.3	±12.60	+.19	11.42	.64	157
9–10 to 10–1	I.Q. 111.2	±10.39	+.54	9.4	.88	57
Sixth Grade						
9–6 to 16–3	C.A. 145.9	±14.94	+.582	12.39	.5	400
	I.Q. 93.1	±15.95	+.075	17.13	.5	
10–6 to 12–5	C.A. 138.9	± 5.48	+.23	3.94	.23	252
	I.Q. 99.9	±12.56	+.36	12.57	.53	
10–6 to 11–5	I.Q. 103.5	±12.25	+.34	11.36	.73	117
10–11 to 11–1	I.Q. 104.7	±11.50	+.59	10.98	1.31	35

Note: Figures for the chronological age are in months.

Second, each grade was divided into the following sub-groups:

Grade 3		*Grade 5*		*Grade 6*	
Group	Age	Group	Age	Group	Age
A	7–6 to 8–5	A	8–11 to 9–5	A	9–6 to 10–5
B	8–6 to 9–5	B	9–6 to 10–5	B	10–6 to 11–5
C	9–6 to 10–5	C	10–6 to 11–5	C	11–6 to 12–5
D	10–6 to 11–5	D	11–6 to 12–5	D	12–6 to 13–5
		E	12–6 to 13–5	E	13–6 to 14–5

Tables were prepared for each group showing the number of cases in the group, the number of passes, and the percentage of passes. These tables will be used in a study of the relative difficulty of the separate tests in the various age groups which represent children accelerated, normal or retarded one, two, or three years (Tables II, III, and IV). The percentages in these tables are based upon the actual number of children taking each separate test and are calculated accordingly.

Third, out of each grade were taken three groups. In the third grade these groups represent the children in the grade who are eight years of age, the age of normal expectancy as to a child's reaching the grade; in the fifth grade these groups represent the

children in the grade who are ten years of age; in the sixth grade these groups represent the children who are eleven years of age. These groups represent three efforts to obtain an order of difficulty based upon a chronological age within the limits of a single grade. Tables V, VI, and VII give the percentage of passes of each test and a probable error value which shows the relative difficulty of each test with reference to every other test and with reference to an absolute zero of difficulty. The percentages in these tables are based on the assumption that the child is able to pass all the tests prior to his own basal age.

Group I in these tables represents children who are within two months of the age represented by the group. In the third grade the eight-year group is comprised of all the children between 7–10 and 8–1; in the fifth grade, all the children from 9–10 to 10–1; in the sixth grade, all the children from 10–10 to 11–1. This group is selected because in standardizing the Stanford Revision Terman tested at each age children that were within two months of a birthday. The table therefore represents an order of difficulty for Terman's eight-year group who are in the third grade, his ten-year group in the fifth grade, his eleven-year group in the sixth grade of the schools under investigation. Group II represents a group within six months of each birthday, the third grade, 7–6 to 8–5; the fifth, 9–6 to 10–5; the sixth, 10–6 to 11–5. It includes all the children in group I. Group III, in each case, represents a group of children covering two chronological years, in grade three, 7–6 to 9–5; in grade five, 9–6 to 11–5; and in grade six, 10–6 to 12–5. In grade three, 68.26 per cent of the cases fall between the chronological ages of 8.3 and 9.2. In grade five, 68.26 per cent of the cases fall between the chronological ages of 10.02 and 11.02; in grade six, 68.26 per cent of the cases fall between 11.1 and 12.03. In each case they represent very closely a group in which over two thirds of the cases are included within a single chronological age: 8 to 9, 10 to 11, 11 to 12. For all practical purposes, then, group III in each grade may be considered as a group, 68.26 per cent of which represents the age of normal expectancy of the group.

These three groups, therefore, represent eight-, ten- and eleven-year-old children taken according to the various methods that have been proposed for defining the age of a child. Terman's method is to take a child within two months of a birthday; Thorndike and

others, six months preceding to six months succeeding;[3] while still other investigators take the child from one birthday to another.

I

Retardation and the Tests

The first objective of the study is to show the relation between percentage of successes in passing a test and acceleration or retardation in school work. Table II presents four third grade groups.

Table II

Third Grade. Number and Per Cent of Successes

Test No.	Group	A		B		C		D	
	Chronological Age	7–6 to 8–5		8–6 to 9–5		9–6 to 10–5		10–6 to 11–5	
	Test Name	No.	%	No.	%	No.	%	No.	%
	Cases	*51*		*82*		*35*		*6*	
7: 1	Fingers	50	98.0	82	100	34	97.1	6	100
7: 2	Pictures, description	50	98.0	79	96.3	32	91.4	6	100
7: 5	Differences	47	92.1	70	85.3	30	85.7	4	66.6
7: 6	Copies diamond	48	94.1	78	95.1	33	94.2	6	100.0
	Cases	*85*		*134*		*52*		*15*	
8: 2	Counts 20–0	82	96.4	124	92.5	49	94.2	13	86.6
8: 3	Comprehension 3°	66	77.6	105	78.3	46	88.4	13	86.6
8: 4	Similarities 2	56	65.8	76	56.7	30	57.6	8	53.3
8: 6	Vocabulary 20	50	58.5	79	58.9	31	59.6	10	66.6
	Cases	*108*		*179*		*70*		*15*	
9: 1	Date	88	81.4	146	81.5	47	67.1	9	60.0
9: 3	Making change	82	75.9	133	74.3	47	67.1	11	73.3
9: 4	R.M.S. 4	40	37.0	68	37.9	24	34.2	4	26.6
9: 5	Three words	94	87.0	153	85.4	60	85.7	12	80.0
	Cases	*113*		*190*		*72*		*17*	
10: 1	Vocabulary 30	12	10.6	25	13.1	7	9.7	4	23.5
10: 2	Absurdities	35	30.9	63	33.1	17	23.6	9	52.9
10: 5	Comprehension 4°	30	26.5	56	29.4	12	16.6	4	23.5
Alt. 1	A-V.M.S. 6	57	50.4	82	42.6	30	41.6	6	35.2
	Cases	*113*		*190*		*74*		*17*	
12: 1	Vocabulary 40	1	0.8	2	1.0	2	.29	1	5.8
12: 4	Dissected sentences	5	4.4	13	6.8	6	8.1	0	0
12: 5	Fables 4	14	12.3	26	13.6	7	9.7	3	17.4
12: 6	R.M.S. 5	3	2.6	7	3.7	2	.29	0	0
12: 7	Pictures, interpretation	13	11.5	20	10.5	7	9.7	0	0
12: 8	Similarities 3	5	4.4	19	10.0	8	10.8	2	11.7
14: 1	Vocabulary 50	0	0	0	0	1	1.3	0	0
14: 4	Problems of fact	1	0.8	1	0.5	4	5.4	2	11.7
14: A1	A-V.M.S. 7	7	6.2	17	8.9	6	8.1	1	5.8
16: 2	Fables 8	0	0	1	0.5	1	1.3	0	0
16: 4	Enclosed boxes	0	0	0	0	2	.29	0	0
18: 3	A-V.M.S. 8	1	0.8	5	2.6	0	0	0	0

[3] Thorndike, Edward L. The Significance of the Binet Mental Ages. *Psychol. Clinic*, 1914, 8, 185–189.

Group A consists of those who are rightly placed in grade on the assumption that children enter the first grade sometime between five years and six months and six years and six months. Group B consists of those who are one year retarded; group C of those who are two years retarded; group D of those who are three years retarded. Tables III and IV present five groups in the fifth and

TABLE III

FIFTH GRADE. NUMBER AND PER CENT OF SUCCESSES

Test No.	Group	A		B		C		D		E	
	Age	8–11 to 9–5		9–6 to 10–5		10–6 to 11–5		11–6 to 12–5		12–6 to 13–5	
	Test Name	No.	%	No.	%	No.	%	No.	%	No.	%
	Cases	*8*		*80*		*107*		*44*		*34*	
9: 1	Date	6	75.0	77	96.2	106	99.0	43	95.4	32	94.1
9: 3	Making change	8	100	78	98.11	107	100	43	95.4	34	100
9: 4	R.M.S. 4	8	100	57	71.2	73	69.1	25	56.8	18	52.9
9: 5	Three words	8	100	77	96.2	106	99.0	44	100	33	97.0
	Cases	*16*		*149*		*168*		*76*		*45*	
10: 1	Vocabulary 30	11	68.7	130	87.2	128	75.0	64	84.2	33	73.3
10: 2	Absurdities	14	87.5	142	95.3	145	87.5	63	82.8	37	82.2
10: 5	Comprehension 4°	14	87.5	114	76.5	134	80.9	58	76.3	29	64.4
Alt. 1	A-V.M.S. 6	12	75.0	99	65.7	87	51.7	41	53.9	18	40.0
	Cases	*17*		*155*		*175*		*77*		*46*	
12: 1	Vocabulary 40	2	11.7	47	30.3	53	30.2	16	20.7	5	10.8
12: 4	Dissected sentences	9	52.9	83	53.5	85	48.5	35	45.4	12	26.0
12: 5	Fables 4	7	41.1	94	60.6	108	62.0	45	58.4	22	47.8
12: 6	R.M.S. 5	6	35.2	32	20.6	31	17.7	6	7.7	3	6.5
12: 7	Pictures	9	52.9	74	47.0	87	49.7	36	46.7	19	41.0
12: 8	Similarities 3	7	41.1	72	46.4	92	52.5	36	46.7	14	30.4
	Cases	*17*		*156*		*175*		*77*		*46*	
14: 1	Vocabulary 50	0	0	5	3.2	6	3.4	2	2.5	1	2.1
14: 3	President & King	1	5.8	5	3.2	10	5.7	5	6.4	1	2.1
14: 4	Problems	1	5.8	34	21.9	35	20.0	16	20.6	6	13.0
14: A1	A-V.M.S. 7	6	35.2	32	20.6	22	12.5	8	10.3	6	13.0
16: 1	Vocabulary 65	0	0	0	0	0	0	0	0	0	0
16: 2	Fables 8	1	5.8	19	12.2	14	8.0	10	12.9	1	2.1
16: 4	Enclosed boxes	0	0	17	10.9	13	7.4	4	5.1	0	0
16: 5	R.M.S. 6	0	0	4	2.5	3	1.7	1	1.2	0	0
18: 3	A-V.M.S. 8	0	0	3	1.9	6	3.4	2	2.5	0	0
18: 4	Passage heard	0	0	2	1.2	0	0	0	0	0	0

sixth grades respectively. Group A in each grade includes those who are one year accelerated; group B, those who are rightly placed as to grade; group C, those who are one year retarded; group D, those who are two years retarded, and group E, those who are three years retarded. It will be noted that in the third

TABLE IV

SIXTH GRADE. NUMBER AND PER CENT OF SUCCESSES

Test No.	Group / Age / Test Name	A 9–6 to 10–5 No.	A %	B 10–6 to 11–5 No.	B %	C 11–6 to 12–5 No.	C %	D 12–6 to 13–5 No.	D %	E 13–6 to 14–5 No.	E %
	Cases	*9*		*51*		*68*		*38*		*17*	
9: 1	Date	9	100	48	94.1	67	98.5	38	100	10	58.8
9: 3	Making change	9	100	50	98.0	67	98.5	38	100	11	64.7
9: 4	R.M.S. 4	7	77.7	36	70.5	57	86.7	24	63.1	6	35.2
9: 5	Three words	7	77.7	50	98.1	61	89.4	35	92.1	11	64.7
	Cases	*16*		*105*		*129*		*62*		*32*	
10: 1	Vocabulary 30	9	56.2	81	77.1	95	74.4	37	59.6	16	50.0
10: 2	Absurdities	16	100	97	92.3	123	95.3	58	93.5	19	59.3
10: 5	Comprehension 4°	12	75.0	84	80.0	108	83.7	45	72.5	16	50.0
Alt. 1	A-V.M.S. 6	15	93.7	85	80.9	98	75.9	41	66.0	12	37.5
	Cases	*19*		*116*		*135*		*63*		*32*	
12: 1	Vocabulary 40	5	26.3	45	39.6	51	34.4	12	18.9	1	3.1
12: 4	Dissected sentences	11	57.9	84	72.4	79	58.5	20	31.7	8	25.0
12: 5	Fables 4	11	57.9	83	71.5	79	58.5	37	58.7	10	31.2
12: 6	R.M.S. 5	9	47.3	25	21.5	31	22.9	13	20.6	4	12.5
12: 7	Pictures	10	52.6	71	61.2	76	56.2	29	46.0	9	28.1
12: 8	Similarities 3	6	31.5	68	58.6	73	54.0	28	44.4	10	31.2
	Cases	*19*		*117*		*135*		*63*		*32*	
14: 1	Vocabulary 50	2	10.5	8	6.8	5	3.7	2	3.1	0	0
14: 3	President & King	1	5.2	21	17.9	11	8.1	8	12.6	1	3.1
14: 4	Problems	4	21.0	37	31.6	37	27.4	16	25.3	4	12.5
14: A1	A-V.M.S. 7	6	31.5	30	25.6	28	20.7	11	17.4	1	3.1
16: 1	Vocabulary 65	1	5.2	0	0	0	0	0	0	0	0
16: 2	Fables 8	1	5.2	20	17.0	16	11.8	9	14.2	0	0
16: 4	Enclosed boxes	1	5.2	15	12.8	16	11.8	3	4.7	0	0
16: 5	R.M.S. 6	2	10.5	3	2.5	7	5.1	1	1.5	0	0
18: 3	A-V.M.S. 8	0	0	7	5.9	4	2.9	2	3.1	0	0
18: 4	Passage heard	0	0	1	.8	0	0	0	0	0	0

grade there is no accelerated group. There were only three pupils in this grade who were younger than seven years and six months. In each of the grades, third, fifth, and sixth, we have eliminated from the study pupils who are retarded four years and over because in each year there are too few cases for valid comparison. The elimination reduced the number of children studied to eight hundred and eighty-six. Four hundred and ten children in the three grades were retarded four years and over.

Third Grade

Seven Year Tests. In group A, 51 out of 113, or 45 per cent, took the seven-year tests; in group B, 82 out of 190, or 43 per cent; in group C, 35 out of 74, or 47 per cent; and in group D, 6 out of 17, or 35 per cent.

As only 6 of group D took the tests, it may well be left out of consideration. The only failures in the group were two failures in differences. In the other three groups, picture description shows a decrease from group to group. Differences show also some effect of retardation although groups B and C pass the tests with approximately the same percentage. In copying the diamond, group A has the lowest percentage of passes. The difference between the three groups is not large.

The two tests that seem to show greatest effect of retardation at the seven-year level are picture description and differences. Fingers shows very little difference in any of the groups. By the time children reach the third grade they know how many fingers are on the right and the left hand and on both hands. This test is no test for third grade children. Copying a diamond is largely a test of motor coordination and may be rated with fingers as a test that is passed by all but a very small percentage of children in the third grade. There were only ten failures out of the 174 cases under consideration, or 5.7 per cent. Differences is passed by all but 10.9 per cent of the 174 cases; pictures by all but 6.3 per cent.

Eight Year Tests. Of the eight-year tests, two tests show an increase from age to age, and, therefore, with degree of retardation; comprehension—third degree, and vocabulary 20. The effect of age and experience in these two cases is thus illustrated. While comprehension calls for the use of a congenital ability, it calls for it in situations that become more familiar to children as they advance in age. Vocabulary also increases with age and school experience. The difference, however, between groups A and D is not great, about 8.1 per cent, but is sufficient to indicate the bearing of age and schooling on vocabulary. Counting backwards and similarities show in the main a tendency to receive a decreasing number of passes with degree of retardation though with exceptions. Group C exceeds group B in counting backwards by 1.7 per cent, and in similarities, by .9 per cent.

Nine Year Tests. All the tests in this group with one or two exceptions to be noted show a very slight decrease in percentage from group to group. The exceptions are date and reverse attention span four, where the difference between groups A and B is very slight and that difference is in favor of group B. In the main, however, these four tests show a tendency to receive a decreasing number of passes with increasing retardation in school.

Ten Year Tests. Of the four tests in this group, audito-vocal attention span six best shows the effect of retardation, being a decrease from 50.4 per cent in group A to 35.2 per cent in group D. Vocabulary 30 shows an increase from group to group with the exception that group C is inferior to group B. The same tendency of vocabulary to increase with age and schooling is noted here as with vocabulary 20, and this despite retardation in school. Absurdities shows a similar increase from age to age and with degree of retardation with the exception that group C is inferior to all the other groups. Absurdities taps a congenital ability—comprehension, but again in situations with which older children are more likely to be familiar than younger children. This is probably one of the tests where it is most difficult to separate between native and acquired ability. Comprehension, fourth degree, shows an increase from the first to second groups, then a slump in the third group, then an increase in the fourth group.

Twelve Year Tests. In vocabulary 40 only 5 children out of 394 passed the test. None of group A succeeded in passing, only one of group D and two of group B and group C. In dissected sentences, the number of passes increases with age although there are no successes in group D. Again it would appear as if some other factor than congenital ability were involved in this test. The older children despite retardation succeeded better than the younger ones. The same remark may be made in regard to fables. There is an increase from group to group with the exception that group C is inferior to group D. Five digits reverse shows the effect of retardation among the retarded groups. Group A, however, is slightly behind group B. Picture interpretations gives the most consistent picture at this level of the influence of retardation. There is a decrease in number and percentage of passes, though slight, from group to group, group D having no successes at all. Five digits reverse and pictures show the best negative correlation with retardation. Success varies inversely with the degree of retardation. Similarities (three things) shows no great variation among groups B, C, and D. Group A, however, is inferior to all of them. The ability to note similarities is a congenital ability that develops with age. The figures seem to bear this out.

Fourteen Year Tests. Vocabulary 50 was passed by only one member of the entire grade. This child is two years behind grade. Problems of fact is passed by only eight, one in group A, one in

group B, four in group C and two in group D. Audito-vocal attention span seven shows no great differences between the groups with the exception of the most retarded group. While the attention span tests in this grade prove to be good indices of retardation, we meet a phenomenon here which we will meet again among the retarded groups. There are a number of children, seventeen, to be exact, in group B, six in group C, and one in group D, who passed this test. This leads to the reflection that other things besides congenital ability enter into the situation in determining a child's grade in school. Lateness in entrance, physical condition and motivation are complicating factors.

Fifth and Sixth Grades

Nine Year Tests. In the accelerated group A, eight out of seventeen subjects took the nine-year tests. Of these eight, six passed all the tests and two failed date. The percentages of passes of date, making change, and three words in sentence in groups B, C, and D show such slight variations that it may be concluded that these tests are approximately of the same difficulty for the children of all the age levels of the fifth grade. No effect of retardation is discernible. The reason why these children were submitted to this test is due to the method employed in finding the best place in which to start the child. The failure to give Vocabulary 30, for example, would start the child back of the tenth year. Failure to give four digits reverse would accomplish the same thing. With the reverse attention span four there is a different story told than that given by the other three tests in this group. The number of passes decreases from 100 per cent in group A to 52.9 per cent in group E. It is safe to conclude that a potent cause of retardation is a deficit in attention span.

The sixth grade repeats the story as far as date, making change, and three words are concerned, though the effect of retardation is shown strikingly in group E. The reverse attention span four presents a slightly different picture from that of the fifth grade. The percentages grade down from 77.7 to 35.2, with the exception that group C excels all with a percentage of 86.7.

Ten to Eighteen Year Tests. These tests appeared to fall into five general classes:

(1) Those tests which show a decreasing percentage of passes from group A to group E.

(2) Those tests which show a decreasing percentage of passes from group B to group E, group A not proving to be superior to group B.

(3) Those tests which show a decreasing percentage of passes with the degree of retardation but with exceptions to the rule of decrease from group to group.

(4) Those tests in which group A and group E have the least percentages of passes while there is no marked difference in groups B, C, and D.

(5) Two tests that show no definite tendency in either grade.

(6) One test which is passed by only two of the entire group in fifth grade and by only one in the sixth grade.

1. The first class consists of the following attention span tests: audito-vocal attention span six and seven, reverse attention span four and five in both grades, and comprehension, fourth degree, in the fifth grade. The most consistent picture is presented by the attention span tests, forward and reverse, listed above. Our tables show that despite the increase in chronological age from group to group there is a decreasing percentage of passes. The best single test evidencing acceleration or retardation in school work is, therefore, the attention span test. Success in the audito-vocal and reverse attention span tests correlates highly with success in school work while a deficit correlates equally well with school retardation. The argument for this becomes *a fortiori* when consideration is given to the fact that the general tendency of the memory span is to increase with age. The conclusion is inescapable that the presence of the quality or complex of qualities tested by the attention span, audito-vocal and reverse, is a powerful factor in acceleration while a deficit is an equally potent factor in retardation in school work.

It is significant also that the other two attention span tests for digits passed by members of these two grades, reverse attention span six and audito-vocal attention span eight, are not passed by any group A in the fifth grade. In this grade, reverse attention span six is passed by only four in group B, by three in group C, and one in group D, a total of eight passes out of the three hundred and three cases considered. In the sixth grade none of group A passed audito-vocal attention span eight, while seven of group B, four of group C and two of group D succeeded in making a total of thirteen successes out of two hundred and fifty-two cases. Six digits reverse was passed by two out of nineteen of group A, by

three of group B, seven of group C, and one of group D, making a total of thirteen passes out of two hundred and fifty-two cases. The failure of any in group A, fifth grade, to pass either of these tests and any in group A, sixth grade, to pass audito-vocal attention span eight is an indication that the attention span increases with age. Audito-vocal eight, reverse attention span six, are beyond the reach of the group A children in the fifth and sixth grades, with the exception of two successes in reverse attention span six in the sixth grade.

On the contrary, we find among the older children in groups B, C, and D a number of passes. The failure of group A is due to the fact that attention span is a function of age. The fact that some few of the retarded children succeed in passing both of these tests is sufficient to caution us against regarding any one single factor as all sufficient to account for school retardation. To discover the reason why the children with this superior attention span are found in the retarded group, it would be necessary to make an investigation of each single case. It is safe to conclude that the causes of retardation are numerous and that there are many reasons why a child with a superior intellectual structure fails to make school progress.

2. There are four tests which show a decrease in percentage of passes from group B to group E. They are (1) Absurdities, (2) Dissected Sentences, (3) Problems of Fact, (4) Enclosed Boxes. In each of these tests group A in both grades fails to hold first position. There are one or two exceptions which will be noted in passing. In the fifth grade the percentage of passes of absurdities decreases with retardation without exception. In the sixth grade the story is not quite as consistent. All of group A pass the test. Group B shows a slightly smaller percentage of passes than groups C and D. Dissected sentences presents in both grades a consistent picture of decrease with degree of retardation with the exception of group A in both grades, which is inferior in number of passes to group B. Problems tells approximately the same story as dissected sentences. Only one in group A in the fifth grade and four in the sixth pass this test. Enclosed boxes shows a decreasing number of successes with degree of retardation. There are, however, no passes in group E of either grade and there is only one pass in group A in the sixth grade.

3. The tests in group three include those which tell a fairly consistent story of decrease in percentage of successes with degree

of retardation, with, however, certain exceptions that are to be noted in all the tests of this group. Group A is inferior to group B in percentage of passes. In both grades vocabulary 30 decreases in percentage of successes with retardation from group B to group E. The exception is in the fifth grade where group D excels group C. In vocabulary 40 there is a decreasing percentage of successes with degree of retardation with the exception that group C and group B in the fifth grade are approximately equal.

In vocabulary 50 there are seventeen passes in the fifth grade and fourteen in the sixth grade; in vocabulary 65, only one.

Vocabulary is one of the essential tools which boys and girls must use in acquiring an education. Its use is essential to progress. It is not surprising to find that the retarded are deficient in vocabulary. There is a significant contrast, however, between the percentage of successes in the vocabulary test and percentage of successes in the attention span test in group A. In the attention span test group A excels all groups. In vocabulary 30 group A is inferior to all groups in the fifth grade, and to all but group E in the sixth grade. In vocabulary 40, group A is inferior to all groups except groups D and E in the fifth grade, and to all but D and E in the sixth grade.

The vocabulary test is presumed to correlate with the Binet-Simon battery as a whole very closely. As the Binet-Simon Test is undoubtedly based in the main upon what boys and girls learn in school it would be expected that success in vocabulary should correlate highly with school achievement. However, our study would seem to indicate that its importance for school progress is not nearly as great as that of the attention span. Children whose vocabulary is inferior to all the children in the group except those who are retarded three years are able to succeed in school work and to make advanced standing despite the relative deficit of vocabulary. It would appear therefore that a good attention span more than compensates for a relatively poor vocabulary.

Terman says, "The vocabulary test has a far higher value than any other single test in the scale. . . . Our statistics show that in a large majority of cases the vocabulary test alone can give us an I.Q. within ten per cent of that secured by the entire scale. . . . Many experiments . . . have proved its value as a test of intelligence."[4] The average I.Q. in our groups decreases with age. Accelerated groups have the highest average and the decrease is

[4] Terman, L. M. The Measurement of Intelligence, p. 231.

unbroken down to the three-year retardates. The coefficient of correlation between vocabulary and I.Q. in group B, fifth grade, is $0.55 \pm .04$. In this group there are 154 cases. Even this correlation is not high enough to be significant. It is only 17 per cent better than chance. Linguistic facility is no guarantee of ability to progress in school. Many retarded children in clinical experience proved to be charming conversationalists, yet are totally without ability to read and do arithmetic. No verbal fluency avails to help them acquire reading when there is a deficit of attention span. What is needed for school progress is a very specific language ability—the ability to use words as symbols of thought. Analytical discrimination and synthetic comprehension are necessary to use language as tools in thinking. The success of the accelerated over the normal and of the normal over the retarded groups may safely be presumed to lie in this direction. The Binet-Simon Test, be it said in appreciation of its value, demands such use of language, and high I.Q.'s are more likely to be found among children who have such ability and efficiency in exploiting it than those who are able to give passable definitions of words.

Comprehension, fourth degree, is the only other test which approaches the consistency of the memory span test, and that in the fifth grade alone. In this grade the curve runs down from group A to group E. In the sixth grade group A is inferior to groups B and C, and group B to group C. Picture interpretation in the fifth grade, like comprehension, fourth degree, presents a picture of gradual decrease from the youngest to the oldest groups with the exception of slight superiority of group C over group B. In the sixth grade the story is the same with the exception that group A has a lower percentage than groups B and C.

4. There are two tests in which groups A and E have the least percentage of passes, while there is no marked difference in the three middle groups: fables (score 4) and similarities (three things). In fables, group A and group E in both grades have the lowest score. In the fifth grade the difference is only six per cent. Groups B, C, and D show no significant differences with the exception that in the sixth grade group B leads groups C and D by twelve per cent. In similarities (three things), groups A and E bring up the rear in both grades. There is not much difference between the three middle groups in the fifth grade though group C exceeds all groups. In the sixth grade there is a decreasing percentage of passes from group B to group E.

5. In president and king, there were 22 successes in the fifth grade, 42 in the sixth grade. In fables (score 8), there were 45 successes in the fifth grade and 46 in the sixth. No definite tendency is shown in the percentage of successes in either test.

6. Repeating the thoughts of a passage heard. Only two successes are recorded in the fifth grade and these are in group B; in the sixth grade only one, and this one in group B.

Summary

The tests that consistently show decrease in percentage of passes with degree of retardation are:

Third grade	*Fifth grade*	*Sixth grade*
Making change.		
Six digits forward.	Six digits forward.	Six digits forward.
Picture description.	Six digits reverse.	Seven digits forward.
Picture interpretation.		Vocabulary 50.

The tests that show a decrease in percentage of passes with degree of retardation, with one or two breaks in the order, are:

Third grade	*Fifth grade*	*Sixth grade*
Differences.	Four digits reverse.	Three words.
Counting backward.	Comprehension, fourth degree	Four digits reverse.
Similarities, two things.	Picture interpretation.	Comprehension, fourth degree.
Four digits reverse.	Seven digits forward.	Five digits reverse.
Three words.		Six digits reverse.
		Absurdities.

The tests that show decrease in percentage of passes with degree of retardation, with one or two breaks in the order, and with group A proving inferior to one or more groups, are:

Third grade	*Fifth grade*	*Sixth grade*
Copying diamond.	Vocabulary 30.	Vocabulary 30.
Date.	Absurdities.	Vocabulary 40.
Vocabulary 30.	Vocabulary 40.	Dissected sentences.
Absurdities.	Fables, 4 and 8.	Picture interpretation.
Comprehension, fourth degree.	Dissected sentences.	Similarities, three things.
Fables, 4.	Similarities, three things.	Fables, 4 and 8.
Five digits reverse.	Vocabulary 50.	President and king.
Seven digits reverse.	Problems.	Enclosed boxes.
	Enclosed boxes.	Eight digits forward.
	Six digits reverse.	

Of the three grades, the third alone shows an increase in percentage of passes with degree of retardation in certain tests. These tests are: Comprehension, third degree; vocabulary 20, dissected sentences; similarities, three things. In the last named test, however, group B is slightly inferior to group A.

II

Order of Difficulty

The second objective of this study is to arrange the separate tests according to the degree of difficulty as shown by the percentage of passes of each test. Tables of order of difficulty were prepared for each grade. Table V gives the order of difficulty of the third

Table V

Order of Difficulty. Third Grade

Group I—Age 7–10 to 8–1			Group II—Age 7–6 to 8–5			Group III—Age 7–6 to 9–5		
Test	%	P.E.V.	Test	%	P.E.V.	Test	%	P.E.V.
1. Fingers	100	0.00	Fingers	99.1	2.50	Fingers	99.6	1.95
2. Pictures	100	0.00	Pictures	99.1	2.50	Pictures	98.6	2.70
3. Diamond	100	0.00	Diamond	98.2	2.85	Diamond	97.6	3.00
4. Differences	97.3	3.10	Differences	97.3	3.10	20–0	95.7	3.40
5. 20–0	94.6	3.47	20–0	97.3	3.10	Differences	94.7	3.55
6. Comprehension 3°	83.7	3.67	Three words	87.5	4.25	Three words	85.4	4.39
7. Three words	83.7	3.67	Comprehension 3°	83.1	4.53	Comprehension 3°	84.1	4.46
8. Vocabulary 20	82.8	4.55	Date	82.3	4.58	Date	82.5	4.55
9. Similarities 2	67.5	5.28	Change	76.9	4.86	Change	76.2	4.90
10. Date	67.5	5.28	Similarities 2	74.3	4.99	Similarities 2	71.2	5.12
11. Change	67.5	5.28	Vocabulary 20	69.0	5.22	Vocabulary 20	70.2	5.17
12. A-V.M.S. 6	48.6	6.26	A-V.M.S. 6	50.4	5.94	A-V.M.S. 6	45.8	6.10
13. Absurdities	38.1	6.40	R.M.S. 4	39.8	6.35	R.M.S. 4	40.9	6.30
14. R.M.S. 4	28.7	6.74	Absurdities	30.9	6.69	Absurdities	32.3	6.63
15. Comprehension 4°	18.9	7.26	Comprehension 4°	26.5	6.87	Comprehension 4°	28.3	6.80
16. Fables 4	13.5	7.57	Fables 4	12.3	7.67	Fables 4	13.2	7.60
17. Vocabulary 30	10.8	7.78	Vocabulary 30	10.6	7.80	Vocabulary 30	12.1	7.68
18. Pictures	10.8	7.78	Pictures	11.5	7.72	Pictures	10.8	7.78
19. Dissected sent.	8.1	8.02	A-V.M.S. 7	7.9	8.05	A-V.M.S. 7	8.5	8.00
20. Similarities 3	8.1	8.02	Dissected sent.	4.4	8.45	Similarities 3	7.9	8.05
21. A-V.M.S. 7	8.1	8.02	Similarities 3	4.4	8.45	Dissected sent.	5.8	8.30
22. R.M.S. 5	2.7	8.80	R.M.S. 5	2.6	8.85	R.M.S. 5	3.2	8.70
23. Problems	2.7	8.80	Problems	0.8	9.55	A-V.M.S. 8	1.9	9.05
24. A-V.M.S. 8	2.7	8.80	A-V.M.S. 8	0.8	9.55	Problems	0.6	9.75
25. Vocabulary 40	0.0	11.90	Vocabulary 40	0.0	11.90	Vocabulary 40	0.6	9.75
26. Fables 8	0.0	11.90	Fables 8	0.0	11.90	Fables 8	0.3	10.05
39 cases			*190 cases*			*303 cases*		

grade; Table VI, of the fifth grade; Table VII, of the sixth grade. Group I in each grade consists of those children who are within two months of their eighth, tenth, and eleventh birthdays respectively. Group II consists of children who are eight, ten, and eleven years of age, considering each age level from six months prior to

TABLE VI

ORDER OF DIFFICULTY. FIFTH GRADE

Group I—Age 9–10 to 10–1			Group II—Age 9–6 to 10–5			Group III—Age 9–6 to 11–5		
Test	%	P.E.V.	Test	%	P.E.V.	Test	%	P.E.V.
1. Date	100	0.00	Date	99.8	.70	Making change	99.7	0.90
2. Making change	98.2	2.84	Making change	98.7	2.65	Date	98.7	2.65
3. Three words	98.2	2.84	Three words	98.0	2.90	Three words	98.7	2.65
4. Absurdities	94.7	3.55	Absurdities	95.5	3.44	Absurdities	90.9	3.99
5. R.M.S. 4	92.8	3.65	Vocabulary 30	87.3	4.26	R.M.S. 4	88.1	4.20
6. Vocabulary 30	87.7	4.23	R.M.S. 4	85.3	4.40	Vocabulary 30	82.7	4.55
7. Comprehension 4°	75.4	4.95	Comprehension 4°	77.5	4.83	Comprehension 4°	79.1	4.80
8. A-V.M.S. 6	75.4	4.95	A-V.M.S. 6	67.3	5.30	Fables 4	61.3	5.52
9. Fables 4	57.8	5.70	Fables 4	60.9	5.54	A-V.M.S. 6	60.4	5.46
10. Pictures	57.8	5.70	Dissected sent.	53.8	5.74	Dissected sent.	51.0	5.90
11. Dissected sent.	51.8	5.89	Pictures	48.0	5.90	Similarities 3	49.8	5.99
12. Vocabulary 40	36.8	6.00	Similarities 3	46.8	6.09	Pictures	48.9	6.00
13. Similarities 3	29.7	6.69	Vocabulary 40	29.4	6.75	Vocabulary 40	29.5	6.75
14. A-V.M.S. 7	21.0	7.15	Problems	23.4	7.00	Problems	20.9	7.05
15. Problems	17.5	7.28	A-V.M.S. 7	22.0	7.10	R.M.S. 5	19.3	7.25
16. R.M.S 5	14.0	7.55	R.M.S. 5	21.1	7.14	A-V.M.S. 7	16.3	7.40
17. Fables 8	10.5	7.75	Fables 8	12.7	7.55	Fables 8	10.0	7.90
18. Enclosed boxes	10.5	7.75	Enclosed boxes	11.4	7.71	Enclosed boxes	9.0	7.95
19. Vocabulary 50	3.5	8.65	Vocabulary 50	3.4	8.65	President, king	4.5	8.45
20. President, king	3.5	8.65	President, king	3.4	8.65	Vocabulary 50	3.0	8.75
21. R.M.S. 6	3.5	8.65	R.M.S. 6	2.7	8.80	A-V.M.S. 8	2.7	8.80
22. Passage heard	1.7	9.10	A-V.M.S. 8	2.5	8.85	R.M.S. 6	2.1	8.95
23. A-V.M.S. 8	0.0		Passage heard	0.0		Passage heard	0.6	10.75
24. Vocabulary 65	0.0		Vocabulary 65	0.0		Vocabulary 65	0.0	
25. Vocabulary 75	0.0		Vocabulary 75	0.0		Vocabulary 75	0.0	
26. R.M.S. 7	0.0		R.M.S. 7	0.0		R.M.S. 7	0.0	
57 cases			*156 cases*			*331 cases*		

TABLE VII

ORDER OF DIFFICULTY. SIXTH GRADE

Group I—Age 10–10 to 11–1			Group II—Age 10–6 to 11–5			Group III—Age 10–6 to 12–5		
Test	%	P.E.V.	Test	%	P.E.V.	Test	%	P.E.V.
1. Change....	100	0.00	Change....	99.1	2.50	Change....	99.6	2.00
2. Three words	100	0.00	Three words	99.1	2.50	Date.....	99.6	2.00
3. Date.....	97.1	3.14	Date.....	97.4	3.05	Three words	96.8	3.20
4. Absurdities	94.2	3.61	Absurdities	93.1	3.75	Absurdities	94.4	3.60
5. R.M.S. 4 ..	88.5	4.18	R.M.S. 4...	87.1	4.23	R.M.S. 4...	89.6	4.10
6. Comprehension 4° ..	82.8	4.55	A-V.M.S. 6	82.9	4.55	Comprehension 4°...	83.3	4.52
7. Vocabulary 30.....	80.0	4.70	Comprehension 4°...	82.0	4.60	A-V.M.S. 6	79.7	4.74
8. Dissected sent.....	77.1	4.85	Vocabulary 30.....	79.4	4.75	Vocabulary 30.....	76.9	4.85
9. A-V.M.S. 6	77.1	4.85	Dissected sent.....	72.6	5.05	Dissected sent.....	65.0	5.40
10. Fables 4...	68.5	5.24	Fables 4...	71.7	5.10	Fables 4...	64.1	5.42
11. Similarities 3.....	62.8	5.47	Pictures....	61.5	5.52	Pictures....	59.1	5.60
12. Pictures ...	51.4	5.90	Similarities 3.....	58.9	5.65	Similarities 3.....	56.7	5.70
13. Vocabulary 40.....	48.0	5.96	Vocabulary 40.....	39.3	6.35	Vocabulary 40.....	38.4	6.40
14. A-V.M.S. 7	32.3	6.63	Problems ..	31.6	6.65	Problems ..	29.3	6.75
15. Problems ..	29.4	6.75	A-V.M.S. 7	25.6	6.80	A-V.M.S. 7	23.0	7.05
16. President, king.....	23.5	7.00	R.M.S. 5...	22.2	7.08	R.M.S. 5...	22.5	7.07
17. R.M.S. 5 ..	20.0	7.20	President, king.....	17.9	7.31	Fables 8...	14.2	7.55
18. Fables 8...	17.6	7.33	Fables 8...	17.0	7.40	President, king.....	12.7	7.65
19. Vocabulary 50.....	14.3	7.55	Enclosed boxes....	12.8	7.63	Enclosed boxes....	12.3	7.67
20. Enclosed boxes....	11.7	7.70	Vocabulary 50.....	6.8	8.15	Vocabulary 50.....	4.7	8.35
21. A-V.M.S. 8	0.0		A-V.M.S. 8	5.9	8.27	A-V.M.S. 8	4.3	8.50
22. R.M.S. 6 ..	0.0		R.M.S. 6...	2.5	8.85	R.M.S. 6...	3.9	8.55
23. Passage heard....	0.0		Passage heard....	0.8	9.55	Passage heard....	0.3	10.05
24. Vocabulary 65.....	0.0		Vocabulary 65.....	0.0		Vocabulary 65.....	0.0	
25. Vocabulary 75.....	0.0		Vocabulary 75.....	0.0		Vocabulary 75.....	0.0	
26. R.M.S. 7 ..	0.0		R.M.S. 7...	0.0		R.M.S. 7...	0.0	
35 cases			*117 cases*			*252 cases*		

six months succeeding the birthday. Group III in the third grade consists of children between the ages of seven years and six months and nine years and five months; in grade five, children between nine years and six months and eleven years and five months; in grade six, of children between ten years and six months and twelve years and five months.

The statistics for these last three groups for both chronological age and I.Q. are given in Table I. In each group 68.26 per cent of the cases fall approximately between ages eight to nine, ten to eleven, and eleven to twelve.

In these tables three methods of defining a given chronological age level are used: in the first case, two months before and two months after a birthday; in the second case, six months before and six months after a birthday, and in the third case, from birthday to birthday. In each grade group II includes cases in group I and group III cases in group II.

As in all the grades and all the groups the tests run from zero difficulty where there are 100 per cent passes to a maximum difficulty where there are 100 per cent failures, it was decided to express the value of each test in terms of P.E. value according to the methods suggested by Garrett.[4] The P.E. distance of each problem above or below the mean was first computed for each test. This P.E. distance was then converted into a P.E. value, the point of zero difficulty being taken as — 5.95 P.E. from the mean. The tables therefore present the tests in order of difficulty, showing the relative difficulty between each test with reference to every other test and with reference to a point of zero difficulty. The larger the P.E. value, the greater is the difficulty of the test. The point of median difficulty is 5.95. The point of maximum difficulty is 11.90. The percentage of passes and P.E. values are given for each test in Tables V, VI, and VII.

Finally an average P.E. value for groups I, II, and III in each grade was obtained. This average is presumed to express as accurately as the data at hand will permit the relative difficulty of the tests for an eight year old child in the third grade, a ten year old child in the fifth grade, and an eleven year old child in the sixth grade of the Philadelphia public schools. Table VIII presents this average P.E. value for each separate test for eight year olds in the third grade. Table IX presents a comparison of the average P.E. values of the separate tests for the ten year old in grade five and the eleven year old in grade six. The second column presents the average P.E. value for grade five, the fourth column the average P.E. value for grade six of the corresponding tests, the fifth column the average P.E. value of the fifth and sixth grades and the sixth column the P.E. difference between the separate tests. This sixth column shows that the tests grade up by unequal steps, the steps varying from P.E. value .06 to P.E. value 1.21.

[4] Garrett, H. E., *Statistics in Psychology and Education*, p. 103.

TABLE VIII

ORDER OF DIFFICULTY

Average P.E. Values of Three Eight Year Old Groups (Third Grade)

			%	P.E.V.	P.E.V. Dif.
1.	7: 1	Fingers	99.5	1.48	
2.	7: 2	Pictures	99.2	1.73	.25
3.	7: 6	Diamond	98.6	1.95	.22
4.	7: 5	Differences	96.4	3.25	1.30
5.	8: 2	20–0	95.8	3.32	.07
6.	9: 3	Three words	85.5	4.10	.78
7.	8: 3	Comprehension 3°	83.6	4.22	.12
8.	9: 1	Date	77.4	4.80	.58
9.	8: 6	Vocabulary 20	74.0	4.89	.09
10.	9: 3	Change	73.5	5.01	.12
11.	8: 4	Similarities 2	71.0	5.13	.12
12.	10: A1	A-V.M.S. 6	48.2	6.10	.97
13.	9: 4	R.M.S. 4	36.5	6.46	.36
14.	10: 2	Absurdities	33.7	6.57	.11
15.	10: 5	Comprehension 4°	24.5	6.97	.40
16.	12: 5	Fables 4	13.0	7.61	.64
17.	10: 1	Vocabulary 30	11.1	7.75	.14
18.	12: 7	Pictures	11.0	7.76	.01
19.	14: A1	A-V.M.S. 7	8.1	8.02	.26
20.	12: 8	Similarities 3	6.8	8.17	.15
21.	12: 4	Dissected sentences	6.1	8.25	.08
22.	12: 6	R.M.S. 5	2.8	8.78	.53
23.	18: 3	A-V.M.S. 8	1.4	9.13	.35
24.	14: 4	Problems	1.3	9.36	.23
25.	12: 1	Vocabulary 40	.2	11.18	1.82
26.	16: 2	Fables 8	.1	11.28	.10
		303 cases			

We will consider first the order of difficulty of the tests at the different age levels for each grade, using as a basis group III, age 7–6 to 9–5, of whom 68.26 per cent fall between ages 8.3 and 9.2, the mean being 105.4 months, P.E. av. .14. The mean I.Q. for the group is 104, P.E. av. .44.

I. *The Third Grade.*—Cases 303.

In the *seven year tests* the order of difficulty is: (1) fingers, (2) picture description, (3) copying a diamond, (4) differences. The P.E. difference between the first and second tests is .75, between the second and third, .30, and between the third and fourth, .55. The first three tests represent an order of difficulty graded by fairly even steps. Only one child in our group fails to pass finger; only four fail to pass pictures; seven fail to pass copying the diamond; and sixteen fail to pass differences. Differences is decidedly the most difficult test of the group.

In the *eight year tests* the order of difficulty is: (1) counting 20–0, (2) comprehension, third degree, (3) similarities, two things.

TABLE IX

ORDER OF DIFFICULTY

Average P.E. Values of Tests of Three Ten Year Old Groups (Fifth Grade) and Three Eleven Year Old Groups (Sixth Grade)

		%	5th grade P.E.V.	%	6th grade P.E.V.	Average P.E.V.	P.E. Dif.
9: 1	Date	99.1	1.11	98.0	2.73	1.92	
9: 3	Making change	98.8	2.13	99.5	1.50	1.81	—.11
9: 5	Three words	98.3	2.79	98.6	1.90	2.34	.53
10: 2	Absurdities	93.7	3.66	93.9	3.65	3.65	.31
9: 4	R.M.S. 4	88.7	4.08	87.9	5.15	4.11	.46
10: 1	Vocabulary 30	85.9	4.34	78.9	4.76	4.55	.44
10: 5	Comprehension 4°	77.3	4.86	82.7	4.56	4.71	.16
10: A1	A-V.M.S. 6	67.7	5.23	79.9	4.71	4.97	.26
12: 5	Fables 4	60.0	5.58	68.1	5.25	5.41	.44
12: 4	Dissected sent.	52.2	5.84	71.5	5.10	5.47	.06
12: 7	Pictures	51.5	5.86	57.3	5.67	5.76	.29
12: 8	Similarities 3	42.1	6.23	59.4	5.61	5.92	.16
12: 1	Vocabulary 40	31.9	6.50	41.9	6.24	6.37	.45
14: 4	Problems	20.6	7.11	30.1	6.72	6.91	.54
14: A1	A-V.M.S. 7	19.7	7.21	26.9	6.83	7.02	.11
12: 6	R.M.S. 5	18.1	7.30	21.5	7.12	7.21	.19
16: 2	Fables 8	11.0	7.40	16.2	7.43	7.41	.20
16: 4	Enclosed boxes	10.3	7.80	12.2	7.67	7.73	.32
14: 3	President, king	3.8	8.55	18.7	7.32	7.93	.20
14: 1	Vocabulary 50	3.3	8.65	8.6	8.00	8.00	.07
16: 5	R.M.S. 6	2.7	8.80	3.2	8.70	8.75	.75
18: 4	A-V.M.S. 8	2.5	9.85	5.1	8.38	9.11	.36
18: 3	Passage heard	.06	10.85	.05	9.80	10.32	1.21
		Fifth grade—331 cases			Sixth grade—252 cases		

(4) vocabulary twenty. The P.E. difference between the first and second tests is 1.06, between the second and third, .66, and between the third and fourth, .05. Counting backwards is decidedly the easiest test of the group. Similarities and vocabulary twenty are of approximately equal difficulty.

In the *nine year tests* the order of difficulty is: (1) three words in a sentence, (2) date, (3) making change, (4) reverse attention span four. The P.E. difference between the first and second tests is .16, between the second and third, .45, and between the third and fourth, 1.40. The reverse attention span four stands out as being decidedly more difficult than any other test in this group. Starr found that 25 per cent of her seven and eight year old normal children had a reverse attention span of four.[5] Of our group 40.9 per cent reach this score.

In the *ten year tests* the order of difficulty is: (1) audito-vocal attention span six, (2) absurdities, (3) comprehension, fourth de-

[5] Starr, Anna S., The Diagnostic Value of the Audito-Vocal Digit Memory Span, *Psych. Clinic*, 1923, 15, 61–84.

gree, (4) vocabulary thirty. The P.E. difference between the first and second tests is .53, between the second and third, .23, and between the third and fourth, .88. The interesting thing about audito-vocal attention span six is that its P.E. value places it close to the mid-point in the series of tests passed by third grade pupils who are eight years of age. The percentage of passes in this group is 45.8. In Group II 50.4 per cent pass it. It is thus passed by 50 per cent and failed by 50 per cent. It will be of value in clinical experience in locating the child above or below the median of eight year old children in the third grade to remember that audito-vocal attention span six is the test that separates eight year old children in the third grade into two groups, 50 per cent above and 50 per cent below the median. Of Starr's normal 7–8 year old children 28 per cent pass this test.[6]

In the *twelve year tests* the order of difficulty is: (1) fables (score four), (2) picture interpretation, (3) similarities (three things), (4) dissected sentences, (5) reverse attention span five, (6) vocabulary forty. The P.E. difference between the first and second tests is .18, between the second and third, .27, between the third and fourth, .25, between the fourth and fifth, .40, and between the fifth and sixth, 1.05. There is very little difference between fables (score four) and picture interpretation, and also between similarities, three things, and dissected sentences. The variation between these tests is so slight as to mark them of about equal difficulty. Vocabulary 40 stands out very markedly as the most difficult test of this level for our group. Only two of the 303 subjects pass the test.

In the *fourteen year tests* the order of difficulty is as follows: (1) audito-vocal attention span seven, (2) problems of fact. The P.E. difference between the first and second tests is 1.75. Two subjects passed problems of fact, and 26 individuals succeeded in passing audito-vocal attention span seven, or 8.5 per cent. In Starr's group 3 per cent received this score.

In the *sixteen year tests* one individual passed fables (score eight).

In the *eighteen year tests* six individuals passed audito-vocal attention span eight.

[6] *Ibid.*

Summary

Some of the tests at a higher level are easier for our group than those located at a lower level. Counting backwards at the eight year level is easier than differences at the seven. Placing three words in a sentence at the nine year level is easier than all the eight year old tests with the exception of counting backwards. Giving the date and making change at the nine year level are easier than vocabulary 20 and giving similarities between two things at the eight year level. One of the ten year tests, audito-vocal attention span six, is easier than one of the nine year tests, reverse attention span four. One of the twelve year tests, fables (score four), is easier for this group than vocabulary 30 at the ten year level. Of the fourteen year tests, audito-vocal attention span seven is easier for this group than three of the twelve year tests, similarities, dissected sentences, and reverse attention span five. Audito-vocal attention span eight at the eighteen year level is easier than problems of fact at the fourteen year level and vocabulary 40 at the twelve year level. Problems of fact at the fourteen year level is easier than vocabulary 40 at the twelve year level, and fables (score eight) at the sixteen year level. Vocabulary 40 at the twelve year level is easier than fables (score eight) at the sixteen year level.

II. *The Fifth Grade.*—Cases 331. Group III, age 9–6 to 11–5, mean 126.3 months, P.E. av. .32, mean I.Q. 105.2, P.E. av. .49.

In the *nine year tests* the order of difficulty is: (1) making change, (2) date, (3) three words in a sentence, (4) reverse attention span four There were two failures in making change, four in date and in putting three words in a sentence, and fifty-seven in four digits reversed. Again reverse attention span four is the most difficult of the nine year tests. Starr found that 64 per cent of her 9–10 year old normal children passed this test. 88.1 per cent of our fifth grade group and 89.6 per cent of our eleven year olds in the sixth grade succeeded in passing it.

Putting three words in a sentence is easier than date and making change for both fifth and third grade pupils but the difference in difficulty is greater in the fifth grade. Date and making change depend more upon life situations, upon knowledge acquired outside of school. Date would appear to depend more particularly upon the necessity that the child is under of knowing the date. Even among adults there is some difficulty occasionally in saying precisely

what day of the month it is, a difficulty that is testified to by the fact that even business men keep calendars on their desks. Making change, on the other hand, is a test at which facility is acquired both in school and outside. Formal instruction in arithmetic and in the application of elementary arithmetical processes to problems plays a part. Another factor is the opportunity that the child has to make purchases in his own name at the corner grocery store. Reverse attention span, on the other hand, is exploiting a congenital ability and is very little affected by schooling and life's experience. With many of the children tested it is also a novelty. Of the four nine year old tests, then, the reverse attention span is most diagnostic of congenital ability. It is least affected by formal schooling.

In the *ten year tests* the order of difficulty is: (1) absurdities, (2) vocabulary 30, (3) comprehension, fourth degree, (4) audito-vocal attention span six. The P.E. difference between the first and second tests is .56, between the second and third, .35, and between the third and fourth, .66. The ten year old tests prove to be much better graded than the nine year tests.

It is interesting to note that audito-vocal attention span six is the most difficult of the ten year tests for the fifth grade group and the easiest for the third grade. Humpstone shows that the median audito-vocal attention span for eight years is 5.2. The median for our third grade eight year olds is 6.1, higher than the median for Humpstone's eleven year old group. Humpstone's median for the ten year old unselected group is 5.7, an increase of only .5 in two years. The ability tested by the attention span test develops very gradually. It is not to be expected, then, that the increase in audito-vocal attention span ability would show any great gain between the third grade and the fifth grade. However, the percentage of passes in the fifth grade group is 60.4, a considerable increase, but not enough apparently to keep this test the easiest in this group, as it was for the third grade pupils. Starr reported 49 per cent of her 9–10–11 year old normals as passing this test. In our cases 60.4 per cent of the fifth grade group and 79.7 per cent of the sixth grade group are credited with success in this test.

Vocabulary thirty, however, receives a higher rank in this grade than in the third grade. It is second in order of ascending difficulty instead of being last. Vocabulary increases with age and schooling. In the two years intervening between these two grades, vocabulary thirty has decreased in difficulty more rapidly than audito-vocal attention span six, and the reason for this we would attribute to

the influence of experience and schooling in vocabulary increase. Another indication of the effect of schooling and life experience on vocabulary is in the great increase in percentage of passes between the third and fifth grades. The percentage of our third grade pupils is 10.8; of the fifth grade the percentage is 82.7, a striking increase in two years. Vocabulary develops rapidly, while attention span ability lags.

In the *twelve year tests* the order of difficulty is: (1) fables (score four), (2) dissected sentences, (3) similarity, three things, (4) picture interpretation, (5) vocabulary forty, (6) reverse attention span five. The P.E. difference between the first and second tests is .42, between the second and third, .09, between the third and fourth, .01, between the fourth and fifth, .75, and between the fifth and sixth, .50. On the whole, this is an excellent group of tests as far as graded difficulty is concerned. In this grade dissected sentences, similarities, three things, and picture interpretation are of about the same degree of difficulty. The difference is very slight. Similarities, three things, passed by 49.8 per cent is at the median of the tests passed by the fifth grade group. In regard to vocabulary, it should be noted that there are only three successes in vocabulary forty in the third grade, whereas one hundred children, or 30.2 per cent, of the fifth grade pass it. Again we meet with a large increase in the percentage of passes of the fifth grade children over the third grade. The increase is not as large as in vocabulary thirty, where the increase was 71.9 per cent. Reverse attention span five is the most difficult test of the group. Starr reports 20 per cent of her 9–10–11 year old normals as passing it. 19.3 per cent of our fifth grade group and 27.5 per cent of our sixth grade group are credited with success.

In the *fourteen year tests* the order of difficulty is: (1) problems of fact, (2) audito-vocal attention span seven, (3) president and king, (4) vocabulary fifty. The P.E. difference between the first and second tests is .35, between the second and third, 1.45, and between the third and fourth, .30. The percentage of passes of problems of fact in this grade is 20.9. Only .6 per cent of the eight year old children passed the test. Of the children of the eight year old group 8.5 per cent passed the audito-vocal attention span seven test, whereas 16.3 per cent of the ten year old children passed it. Of 156 children, age 9–6 to 10–5, 21.1 per cent are credited with success. Audito-vocal attention span seven is the point, then, that marks off the upper quintile of ten year old fifth grade children.

Just as audito-vocal attention span six is at the median of third grade children, audito-vocal attention span seven is approximately at the 80 per cent line for ten year old fifth grade children. Starr reported 11 per cent of her 9–10–11 year old normals as passing this test. Vocabulary fifty is passed by 3.0 per cent of our ten year old fifth grade children. Seventeen children passed this test out of the entire group of 331 cases. There are no passes at the third grade level.

In the *sixteen year tests* the order of difficulty in the three tests passed by this group is: (1) fables (score eight), (2) enclosed boxes, (3) reverse attention span six. Fables is passed by 33, enclosed boxes by 30, and reverse attention span six by 5 of our 331 cases.

Of the *eighteen year tests* the only ones passed by this group were audito-vocal attention span eight, which was passed by nine, and giving the thoughts of a passage heard, which was passed by only two.

Summary

Absurdities at the ten year level is easier for this group than reverse attention span four at the nine year level. Fables (score four), twelve year level, is easier than audito-vocal attention span six at the ten year level. Problems of fact, fourteen year level, is easier than reverse attention span five at the twelve year level. Fables (score eight) and enclosed boxes, sixteen year level, are easier than reverse attention span six at the sixteen year level.

III. *The Sixth Grade.*—Cases 252. Group III, age 10–6 to 12–5, mean 138.9 months, P.E. av. .23, mean I.Q. 99.9, P.E. av. .53.

In the *nine year tests* the order of difficulty is: (1) making change, (2) date, (3) three words, (4) reverse attention span four. The P.E. difference between three words and reverse attention span four is .90.

The variations between the first three tests in this grade, as in the fifth grade, are not significant. Out of an entire group of 252, two failed at making change, four failed to name the date, eight in giving three words, while twenty-six failed in reverse attention span four. The same situation prevailed as in the fifth grade.

In the *ten year tests* the order of difficulty is: (1) absurdities, (2) comprehension, fourth degree, (3) audito-vocal attention span six, (4) vocabulary thirty. The P.E. difference between the first and second tests is .92, between the second and third, .22, and be-

tween the third and fourth, .10. Absurdities in both fifth and sixth grades is of equal difficulty. Audito-vocal attention span six is easier for the sixth grade group than for the fifth, the P.E. difference being .72, thus showing gradual increase in attention span in one year.

Vocabulary thirty is more difficult for our sixth graders than for the fifth graders, the P.E. difference being .30. The reason for this inferiority of the sixth grade over the fifth grade in vocabulary must be looked for in the difference between the two groups. This is the only point so far where we have noted a decrease in vocabulary rating from grade to grade. The decrease in percentage is 5.8. This inferiority, as indicated by a difference in I.Q., finds its most marked expression at this point. The mean I.Q. for the entire sixth grade is 93.1, P.E. .5, that for the fifth grade, 99.1, P.E. .5.

In the *twelve year tests* the order of difficulty is: (1) dissected sentences, (2) fables (score four), (3) picture interpretation, (4) similarities, three things, (5) vocabulary forty, (6) reverse attention span five. The P.E. difference between the first and second tests is .02, between the second and third, .18, between the third and fourth, .10, between the fourth and fifth, .70, and between the fifth and sixth, .67. All the tests of this group are easier for our eleven year old sixth graders than for our ten year olds in the fifth grade. They all show a small increase in percentage. The difference between the P.E. values of picture interpretation in the fifth and sixth grades is .40, of fables (score four), .10, of similarities, three things, .29, of vocabulary forty, .35, of dissected sentences, .50, and of reverse attention span five, .18. The smallest increase is, therefore, in fables (score four), and the greatest, in dissected sentences. The increase in ability to interpret pictures is represented by a P.E. difference of .40; of dissected sentences by .50. The more rapid development in arranging dissected sentences as compared with picture interpretation, noted between the ages eight and ten, is apparent here also in the interval of one year, though the actual difference is small.

Similarities was passed by 56.7 per cent of the group, and pictures by 59.1 per cent. The percentage of passes of vocabulary forty in this grade is 38.4, which is 8.9 per cent higher than with the ten year olds. This reverses the situation that we found with vocabulary thirty.

In the *fourteen year tests* the order of difficulty is: (1) problems

of fact, (2) audito-vocal attention span seven, (3) president and king, (4) vocabulary fifty. The P.E. difference between the first and second tests is .30, between the second and third, .60, and between the third and fourth, .70. The P.E. difference between problems of fact and audito-vocal attention span seven is approximately the same as that found in the fifth grade. Both of these tests, however, are easier for the sixth grade pupils than for the fifth grade. The P.E. difference for problems of fact is .30, and for audito-vocal attention span seven, .35. Vocabulary fifty is passed by thirteen of the 252 subjects as compared with eleven of the 331 ten year old subjects. In vocabulary thirty we found the eleven year olds inferior to the ten year olds; in vocabulary forty and vocabulary fifty they are superior. A detailed study of the vocabularies of the two groups will be given in a later section.

Of the *sixteen year tests*, those passed by this group are, in order of difficulty: (1) fables (score eight), (2) enclosed boxes, (3) reverse attention span six. The P.E. difference between the first and second tests is .12, and between the second and third, .88. There are thirty-six passes of fables (score eight), thirty-one of enclosed boxes, and ten of reverse attention span six. All the tests of this level have a greater percentage of passes in the sixth grade than in the fifth grade, showing again that the ability involved here develops gradually from year to year.

At the *eighteen year test* level the two tests having passes to their credit are audito-vocal attention span eight, passed by eleven of the 252, and repeating the thoughts of a passage heard, passed by one.

Summary

Absurdities at the ten year level is easier for this group than reverse attention span four at the nine year level. None of the twelve year old tests is easier for our eleven year olds than the tests at the ten year level. Problems of fact and audito-vocal attention span seven at the fourteen year level are easier for our eleven year olds than reverse attention span five at the twelve year level. Fables (score eight) at the sixteen year level is easier than vocabulary fifty and president and king at the fourteen year level. Enclosed boxes at the sixteen year level is easier than vocabulary fifty at the fourteen year level. Audito-vocal attention span eight, eighteen year level, is easier than reverse attention span six. There are eleven passes of audito-vocal attention span eight, and ten passes of reverse attention span six.

Discussion

In the decision of the question of whether a test is located at the proper age level, there are several methods that may be employed. The first is the method used by Binet: "If the percentage of passes for a given test increased but little or not at all in going from younger to older children, this test was discarded. On the other hand, if the proportion of passes increased rapidly with age, and if children of a given age who, on other grounds, were known to be bright passed more frequently than children of the same age who were known to be dull, then the test was judged a satisfactory test of intelligence."[7]

In practice the application of the principle resulted in the placing of a test at a year where it was "passed by two-thirds to three-fourths of unselected children." There is no valid objection to the application of such a percentage basis for the location of a test and one good argument in its favor. If 66.66 per cent or 75 per cent of children of a given chronological age pass a test, it is reasonably certain that the middle 50 per cent can pass it. This is what Binet was interested in primarily. His problem was to separate out of the mass of school children in Paris those that were backward. If a child fails to pass tests that are passed by the modal 50 per cent, he is located, certainly, in the lowest 25 per cent. The concept of mental age introduced by Binet is based upon the performance of the modal child. If a child is able to perform as a modal six year old child performs, he has a mental age of six. It would be better to say that such a child has the performance level of a child of six. The criticism that may be directed against this method is largely one of the grossness of the measure. Knowing the modal performance of children of a given age, we have, as a result, three classifications: modal, superior to the mode, and inferior to the mode.

A second method for locating a test at a given age level is that of Terman. Terman,[8] on grounds which he did not disclose, says, "We had already become convinced for reasons too involved for presentation here that no satisfactory revision of the Binet scale was possible on any theoretical consideration as to the percentage of passes which an individual test ought to show in a given year in order to be considered standard for that year." Consequently,

[7] Terman, *op. cit.*, p. 47.

[8] Terman, *op. cit.*, pp. 53–54.

Terman adopted as his guiding principle an arrangement of tests and a standard of scoring which would cause the median age of the unselected children of each age group to coincide with the median chronological age. The result of the application of Terman's method is that tests are grouped at a given age level that are not well graded in difficulty. This is noticeable in the seven year old tests where three tests are fairly well graded, while the fourth test is exceedingly difficult. The failure of a child to pass the seven year old tests depends on his ability to pass differences. Differences is the decisive test at this level. Of thirty-nine cases in the third grade, eight year old children, according to Terman's method, all pass fingers and diamonds. Differences is the point of elimination. The same thing occurs at the nine year level. Reverse attention span four is a test of outstanding difficulty. In the twelve year old tests this role is played by vocabulary forty.

Another result is that tests are located at higher age levels that are inferior in difficulty to tests at a lower age level. We have already pointed out in this section of our study that for each age or grade group there are tests at higher levels that are easier than tests at lower levels. The scale stands under the criticism of being a battery of tests of graded difficulty, it is true, from age level to age level, but not from test to test.

The third method is that adopted by Lightner Witmer of the University of Pennsylvania, and used in the Psychological Clinic. Dr. Witmer's judgment is that a test is satisfactorily located when it is passed by 50 per cent and failed by 50 per cent of children of a given age level. The Witmer formboard is a four year old test because it is passed by 50 per cent and failed by 50 per cent of four year old children. Reverse attention span of two or more is a six year old test for precisely the same reason. According to this method, we may pick out from the Binet tests audito-vocal attention span six as an eight year old test for third graders in the Philadelphia public schools, as it is passed by 50.4 per cent of eight year old children in the third grade. In the fifth grade, for the same reason, similarities (three things) can be selected as a ten year old test, because it is a test that separates Group III into 50 per cent successes and 50 per cent failures. This method needs no justification from the clinical point of view. Clinical psychology, being a psychology of the individual, must employ as refined a measure as possible. Binet's modal child, we have seen, divides children into three groups; it is a rough measure. Terman's I.Q.

also fails of precision when used for clinical purposes. The difference between I.Q. 90 and I.Q. 140 is great enough to set off or classify children receiving these I.Q.'s. But just what precisely is the difference between I.Q. 95 and I.Q. 105? In order to locate a child it is necessary to state his position in a small group with a certain percentage of inferiors and a certain percentage of superiors of his exact chronological age. The division into quintiles is better for this purpose than the division into halves or thirds. It gives us three modal groups, one superior, and one inferior. The decile grouping gives us a still more refined measure. The first step in forming a decile grouping is to find the median—the test that divides the group, first of all, in half. Such a test may be properly demarcated as a test at the age level where it makes such a division. The first question that a clinician must answer is, where is this child with reference to the median or with reference to a test that has median value?

Assuming that a test is satisfactorily located when it is passed by 75 per cent of the children of a given age level, the following tests are too easy for children in the third grade of the public schools of Philadelphia, of whom 68.26 per cent fall between the ages of eight years, three months and nine years, two months: all of the starred tests of the seven year tests; all of the tests at the eight year level with the exception of similarities (two things) and vocabulary 20; and three words, date, and making change at the nine year level. Assuming that a test is satisfactorily located when it is passed by 50 per cent, we must then add to the list of tests that are too easy for this third grade similarities (two things) and vocabulary 20 at the eight year level, and date and making change at the nine year level. Audito-vocal attention span six is passed by 45.8 per cent. It, therefore, lies next to the median line for this group. With children in the third grade between the ages of 7–6 and 8–5, the percentage of passes is 50.4. Reverse attention span four is passed by 40.9 per cent in Group III and by 39.8 per cent in Group II. It therefore lies on the line which separates the two superior quintiles from the three inferior quintiles.

In the fifth grade, assuming that a test is satisfactorily located if passed by 75 per cent, we must include among those tests that are too easy for our fifth grade group, age 9–6 to 11–5, 68.26 per cent of whom fall between the ages 10.02 to 11.02, the following tests: at the nine year level, making change, date, three words, and reverse attention span four; at the ten year level, absurdities, vocabulary

thirty, and comprehension (fourth degree). Assuming that a test is satisfactorily located if 50 per cent pass, we must add to this group two more, audito-vocal attention span six at the ten year level, and fables (score four) at the twelve year level. There are three tests that are very close to the median line at ten years, being passed by approximately 50 per cent of our eleven year olds in the fifth grade. They are: dissected sentences, passed by 51 per cent, similarities (three things), passed by 49.8 per cent, and pictures, passed by 48.9 per cent of Group III.

Assuming that a test is satisfactorily located when it is passed by 75 per cent, in the sixth grade, Group III, age 10–6 to 12–5, 68.26 per cent of whom fall between the ages 11.1 and 12, date, change, three words, and reverse attention span four at the nine year level; absurdities, comprehension (fourth degree), audito-vocal attention span six at the ten year level and vocabulary thirty, are too easy. Assuming that a test is satisfactorily located when it is passed by 50 per cent, the following tests must be added for Group III: dissected sentences, fables (score four), picture interpretation and similarities (three things). Similarities (three things) is the closest to the median line, being passed by 56.7 per cent of this group. There is a distinct break in difficulty between dissected sentences, similarities (three things) and picture interpretation in the twelve year group, and vocabulary forty, which has 18.4 per cent less passes in the fifth grade group than the test next above it, picture interpretation, and in the sixth grade has 18.3 per cent less passes than similarities.

III

Effect of Grades on the Test

The impressive fact that emerges in comparing the percentage of gain in the passes of the fifth grade over the third grade and of the sixth grade over the fifth is the enormous gain in ability to pass the tests in the two year interval between the third and fifth grades and the meagre gain in the one year interval between the fifth and sixth grades.

In the nine year tests, the percentage of passes by third grade children is so large that no great percentage of increase could be expected. The fifth grade and sixth grade children with few exceptions pass date, making change, and three words. With reverse attention span four the gain per cent of the fifth grade over the

third grade is 115. A gain per cent of 1.7 is shown between the fifth and sixth grades. The range in reverse attention span among normal children from ages six to fifteen has been shown by Starr to be from three to five. The smallness of the increase of the sixth over the fifth grade is not as surprising, therefore, as the greatness of the increase between the third and fifth grades. The increase in gain per cent between the third and fifth grades is to the increase between the fifth and the sixth as 100 is to 1. The sixth grade group is slightly inferior to the fifth grade group. The mean I.Q. of the latter is 110.3, P.E. av. .6; of the former is 99.9, P.E. av. .5, a difference of 10.4. This difference is significant and undoubtedly is shown in the small gain per cent of the sixth grade group over the fifth in this test as well as in others. But the third grade group on the other hand is also inferior to the fifth grade. The mean I.Q. of the third grade group is 108.8, P.E. av. .5. The difference is only 1.5. It is doubtful however whether the large gain in the two year interval over the one year interval is to be attributed entirely to the fact that the sixth grade is inferior to the fifth. There is room for the opinion that sometime between eight and ten years or between the third and fifth grades the child makes such rapid growth intellectually that the ten year level might be called the intellectual level. Nearly 90 per cent of our ten year old fifth graders show a reverse span of four, nearly 20 per cent a reverse span of five, and a superior 2 per cent a reverse span of six.

Considering the tests at year ten, we note that the smallest gain per cent in the two year interval between the third and fifth grades in any test is that of the audito-vocal attention span six, 31.8 per cent. The gain per cent of the sixth grade over the fifth grade is 31.9 per cent. This is the only test where there is a gain in the sixth grade over the fifth that is equal to the gain of the fifth grade over the third. The gain per cent in the one year interval equals the gain per cent in the two year interval. The range of the attention span among normal children is from four to seven or eight digits between ages six and fifteen. Higher spans than eight are given but it is reasonably certain that these higher spans are obtained by grouping. Fernberger's judgment is that the grouping process is employed in all attention spans involving more than five digits.[9] By this standard, 60 per cent of fifth grade children and 80 per cent of sixth grade children have reached their

[9] Martin, Pauline R., and Fernberger, Samuel W. Improvement in Memory Span. *Amer. Jour. Psychol.*, 1929, 41, 91–94.

maximum immediate reproductive attention span. As far as the ability which is involved in this test is concerned these children are all on deck intellectually. It is not however to be supposed that every child who gives a span of six has an immediate attention span of that number of digits, as inferior children of ten very frequently hit upon the device of grouping to increase their span. However it must be noted that the forward span shows no such development as the reverse span does in our two year interval nor is the percentage of passes as great. In the fifth grade 88.1 have a reverse span of four and 60.4 per cent a forward span of six. In the sixth grade 89.6 per cent have a reverse span of four and 79.7 per cent, a forward span of six. Leaming as a result of her investigation of high school children concludes that a forward memory span of six is necessary for successful high school work.[10] As far as attention span is concerned, other factors being equal, it would be possible to make a prognosis of high school success for approximately 60 and 80 per cent of these fifth grade and sixth grade children respectively in the public schools of Philadelphia. The possession of such a span does not imply successful high school work but *not* to possess such a span would be a sure guarantee of failure to do high school work.

Absurdities and comprehension (fourth degree) show approximately the same percentage of gain between the third and fifth grades and also between the fifth and sixth grades, the gain between the latter two grades in both tests being insignificant as compared with the vast gain between the two former. Absurdities (vid. Table VII) is the easier of the two tests. Terman's results show "that eight year intelligence hardly ever scores more than two or three correct answers out of five. By twelve the critical ability has so far developed that the test is nearly always passed."[11] 32.3 per cent of Group III and 30.9 per cent of Group II, third grade; 90.9 per cent of Group III and 95.5 per cent of Group II, fifth grade, pass the test.

Twelve Year Tests. We meet again the same contrast between the gain per cent of passes between the third and fifth grades and between the fifth and sixth. Reverse attention span five makes a remarkable gain of over 500 per cent in the two year interval and a gain of 1.6 per cent in the one year interval, duplicating the

[10] Leaming, Rebecca E. Tests and Norms for Vocational Guidance at the Fifteen Year Old Performance Level. *Psychol. Clinic,* 1922, 14, 193–220.

[11] Terman, *op. cit.,* p. 258.

situation with reverse attention span four. The development of ability to pass the four tests at this level that exploit the analytic-synthetic intellect follows this ascending order: (1) picture interpretation, (2) fables, (3) similarities, (4) dissected sentences, the gain in the two year period being 352, 364, 530, 779 per cent respectively. The gains per cent between the fifth and the sixth range from 4.5 to 27.4 per cent. Dissected sentences make a gain per cent more than double picture interpretation and fables and nearly one and one-half times similarities in the two year interval. Above the ten year level the passes are too few to form the basis of a comparison.

It is impossible to present any adequate picture of the effect of grade on vocabulary by comparison of the percentage of scores of the various vocabulary tests involved in this study, vocabulary 20, 30, 40, and 50. The reason for this is obvious. It lies in the method of scoring vocabulary tests. All subjects scoring between 20 and 29 receive a score of 20, all scoring between 30 and 39 receive a score of 30, etc. In order to know how vocabulary fares in the three grades, a more detailed study becomes necessary. It is decided, therefore, to obtain the mean, the standard deviation, the skewness, Pearson's coefficient of variation, and the probable error of the average for each grade. These facts are presented in the following table:

VOCABULARY TABLE A

Grade	Mean	S.D.	Sk.	V.	P.E. av.
Third	21.1	±6.35	+.54	30.09	.24
Fifth	34.9	±6.45	+.11	18.48	.23
Sixth	35.6	±8.90	−.30	25.00	.37

It will be noted that the mean vocabulary for grade three is 21.1 words, P.E. av. .24. The mean for grade five is 34.9 words, P.E. av. .23. For sixth grade the mean is 35.6 words, P.E. av. .37. The difference between the third and the fifth grades is 13.8 words, or a gain per cent of the fifth grade over the third of 65.4 per cent. The gain of the sixth grade over the fifth is .7 word, which is a gain per cent of .02. As with the other tests, the gain in vocabulary is very striking between the third and the fifth grades and barely noticeable between the fifth and sixth grades.

The range is from 4 to 40 words in the third grade, from 10 to 60 in the fifth grade, and from 10 to 58 in the sixth grade. The

following table presents the number and per cent passing the vocabulary test in five groups: (1) those having a vocabulary under 20, (2) those having a vocabulary from 20 to 29, (3) those having a vocabulary from 30 to 39, (4) those having a vocabulary from 40 to 49, and (5) those having a vocabulary from 50 to 60.

VOCABULARY TABLE B

	III		V		VI	
	No.	%	No.	%	No.	%
(1) under 20	109	35.9	6	1.8	3	1.1
(2) 20 to 29	158	52.1	53	16.0	55	21.8
(3) 30 to 39	33	10.8	172	51.9	97	38.4
(4) 40 to 49	3	0.9	89	26.8	84	33.0
(5) 50 to 60	0	0	11	3.3	13	5.1
	303		331		252	

The mode for the third grade is vocabulary 20 to 29, which is passed by 52.1 per cent of the third graders. A superior 10.8 per cent score between 30 and 39; less than 1 per cent score between 40 and 49. In the fifth grade the mode is 30 to 39, 51.9 per cent. A superior 26.8 per cent reach a vocabulary of 40 to 49, and 3.3 per cent reach a vocabulary of 50 to 60. In the sixth grade the mode is 30 to 39, the same as in the fifth. The per cent is 38.4—13.5 per cent less than the fifth grade. The reason for the inferiority of the sixth grade to the fifth grade must be sought in the nature of the groups.

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